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April 8, 2008 — Date

A Beggs — Alexandra L. Beggs

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No.	: 10/691,122	Confirmation No.	: 5347
Applicants	: Mark A. Moehring et al.		
Filed	: October 21, 2003	Attorney Docket No.	: 500581.08
Art Unit	: 3768	Customer No.	: 27,076
Examiner	: Francis J. Jaworski		
Title	: METHOD AND APPARATUS FOR AUTOMATIC LOCATION OF BLOOD FLOW WITH DOPPLER ULTRASOUND (AS PREVIOUSLY AMENDED)		

Mail Stop Issue Fee
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

TRANSMITTAL WITH ISSUE FEE PAYMENT REGARDING
PREVIOUSLY FILED CHANGE IN APPLICATION TITLE

Sir:

Applicants acknowledge receipt of the Notice of Allowance dated January 8, 2008 and herewith return the Issue Fee payment. Applicants ask the Examiner to note the incorrect title shown on the Notice of Allowance which the applicants have amended on the PTOL-85B.

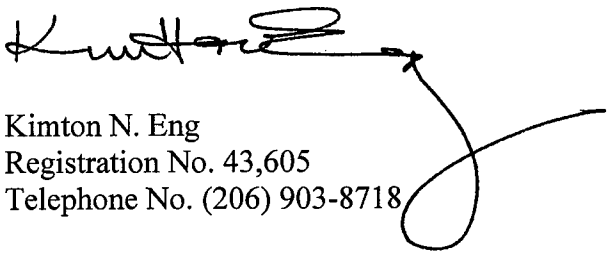
In a Supplemental Preliminary Amendment filed on October 22, 2004 the title of the application was amended from "METHOD AND APPARATUS COMBINING DIAGNOSTIC ULTRASOUND WITH THERAPEUTIC ULTRASOUND TO ENHANCE THROMBOLYSIS" to "METHOD AND APPARATUS FOR AUTOMATIC LOCATION OF BLOOD FLOW WITH DOPPLER ULTRASOUND".

Attempts were made to contact the Examiner, Francis J. Jaworski, whom we understand has now left the Patent Office, and thereafter his SPE, Brian Casler regarding the change in title. None of our telephone messages were returned, and no amended Notice of Allowance has been received.

Applicants request that the title be updated on Patent Office records and the correct title reflected on the issued patent. A copy of the Supplemental Preliminary Amendment is attached hereto.

Respectfully submitted,

DORSEY & WHITNEY LLP



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I hereby certify that on the date specified below, this correspondence is being deposited with the United States Postal Service as first-class mail in an envelope addressed to Mail Stop Amendment, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

October 22, 2004 — Ayesha J. Shaikh

Date — Ayesha J. Shaikh

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No.	: 10/691,122	Confirmation No.	: 5437
Applicants	: Mark A. Moehring, Arne H. Voie and Merrill P. Spencer		
Filed	: October 21, 2003	Attorney Docket No.	: 500581.08 (29666/US/2)
Art Unit	: 3737	Customer No.	: 27,076
Examiner	: Not Yet Assigned		
Title	: METHOD AND APPARATUS COMBINING DIAGNOSTIC ULTRASOUND WITH THERAPEUTIC ULTRASOUND TO ENHANCE THROMBOLYSIS		

SUPPLEMENTAL PRELIMINARY AMENDMENT

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Please amend the above-identified application as follows:

Amendments to the Specification begin on page 2 of this paper.

Amendments to the Claims are reflected in the listing of claims which begins on page 3 of this paper.

Remarks begin on page 17 of this paper.

Amendments to the Specification:

Please amend the title to read as follows:

METHOD AND APPARATUS FOR AUTOMATIC LOCATION OF BLOOD FLOW WITH DOPPLER ULTRASOUND

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application. Please add new claims 87-124, as follows:

Listing of Claims:

1-32. (Cancelled)

33. (Original) A method of treating a patient suffering from thrombosis, the method comprising:

positioning a single ultrasound probe proximate a body surface of the patient, the single probe having a diagnostic mode and a therapeutic mode;

in the diagnostic mode, administering a diagnostic ultrasound from the single probe to the patient at a first frequency ; and

in the therapeutic mode, administering therapeutic ultrasound from the single probe to the patient at a second frequency to enhance a thrombolytic action of a thrombolytic agent.

34-39. (Cancelled)

40. (Original) The method of claim 33 wherein the single ultrasound probe comprises a plurality of transducer elements arranged in an array, the array defining an area.

41. (Original) The method of claim 40 wherein each of the transducer elements is triangular shaped, and the area is hexagonal shaped.

42. (Original) The method of claim 40 wherein each of the transducer elements is rectangular shaped, and the area is polygonal.

43. (Original) The method of claim 40 wherein the plurality of transducer elements comprises 128 transducer elements.

44. (Original) The method of claim 40 wherein administering ultrasound in the diagnostic and therapeutic modes is controlled by a computer.

45-46. (Cancelled)

47. (Original) A method of treating a patient suffering from thrombosis, the method comprising:

selecting a region on a body surface of the patient;

placing on the body surface a single ultrasound probe having a plurality of transducer elements arranged in an array, the array defining a plurality of areas within the region;

administering pulsed ultrasound from the ultrasound probe to a first one of the areas during a diagnostic mode and evaluating a window through that first area;

if the window through the first area is not an optimum window, administering the pulsed ultrasound to a second one of the areas in the diagnostic mode and evaluating a window through the second area, at least a portion of the second area including at least a portion of the first area;

repeating the administration of the pulsed ultrasound to another area in the diagnostic mode if prior areas administered with pulsed ultrasound do not substantially include the optimum window, until an area having substantially the optimum window is located; and

administering the ultrasound in the therapeutic mode from the single ultrasound probe through the area having substantially the optimum window.

48. (Original) The method of claim 47 wherein the ultrasound administered in the therapeutic mode comprises pulsed or continuous-wave ultrasound.

49. (Original) The method of claim 47 wherein each of the transducer elements is triangular shaped, and the area is hexagonal shaped.

50. (Original) The method of claim 47 wherein each of the transducer elements is rectangular shaped, and the area is polygonal shaped.

51. (Original) The method of claim 47 wherein administering the pulsed ultrasound in the diagnostic mode comprises administering the pulsed ultrasound at a frequency different from a frequency of the ultrasound administered in the therapeutic mode.

52. (Original) The method of claim 47 wherein the ultrasound in the therapeutic mode is administered simultaneously with the pulsed ultrasound of the diagnostic mode.

53. (Original) The method of claim 47 wherein administering the pulsed ultrasound in the diagnostic mode, repeating the administering, and administering ultrasound in the therapeutic mode are controlled by a computer.

54-62. (Cancelled)

63. (Original) An apparatus to treat a patient suffering from thrombosis, the apparatus comprising:

a single ultrasound probe structured to transmit pulsed ultrasound in a diagnostic mode, and ultrasound in a therapeutic mode, the ultrasound having a characteristic in the therapeutic mode that is different from a characteristic of the pulsed ultrasound in the diagnostic mode; and

a controller structured to switch the single ultrasound probe between the diagnostic and therapeutic modes and to process ultrasound Doppler signals returned by the single ultrasound probe during the diagnostic mode.

64-67. (Cancelled)

68. (Original) The apparatus of claim 63 wherein the single ultrasound probe comprises plurality of transducer elements arranged in an array, the array defining an area.

69. (Original) The apparatus of claim 68 wherein each of the transducer elements is triangular shaped, and the area is hexagonal shaped.

70. (Original) The apparatus of claim 68 wherein each of the transducer elements is rectangular shaped, and the area is polygonal.

71. (Original) The apparatus of claim 68 wherein the plurality of transducer elements comprises 128 transducer elements.

72-86. (Cancelled)

87. (New) A Doppler ultrasound system for monitoring blood flow, comprising:

an ultrasound transducer having a plurality of ultrasound transducer elements;

an ultrasound pulser circuit operatively coupled to the ultrasound transducer and configured to generate signals to drive a set of elements of the plurality of ultrasound transducer elements to radiate an ultrasound beam;

an ultrasound receiving circuit operatively coupled to the ultrasound transducer and configured to process signals detected from reflections of the ultrasound beam by at least a portion of the plurality of ultrasound transducer elements and generate processed data therefrom representative of reflected signal power of blood flow; and

a computer operatively coupled to the ultrasound pulser circuit and the ultrasound receiving circuit, the computer configured to control the ultrasound pulser circuit to drive different sets of elements of the ultrasound transducer, control the ultrasound receiving circuit to

generate processed data for the different sets of elements, and further configured to analyze the processed data for the different sets of elements to determine a window through which blood flow is detected, the window generally defined by a selected one of the sets of elements for which processed data is provided by the ultrasound receiving circuit and operating conditions for the pulser and receiving circuits for the selected set of elements.

88. (New) The Doppler ultrasound system of claim 87 wherein the ultrasound transducer comprises an ultrasound transducer having an array of triangular shaped ultrasound transducer elements.

89. (New) The Doppler ultrasound system of claim 88 wherein the ultrasound pulser circuit comprises an ultrasound pulser circuit configured to generate signals to drive groups of six triangular shaped ultrasound transducer elements arranged in a hexagonal shape to radiate an ultrasound beam, and the ultrasound receiving circuit comprises an ultrasound receiving circuit configured to process signals detected from reflections of the ultrasound beam radiated by any of the groups of ultrasound transducer elements and generate the processed data therefrom.

90. (New) The Doppler ultrasound system of claim 87 wherein the ultrasound transducer comprises an ultrasound transducer having an array of quadrilateral shaped ultrasound transducer elements.

91. (New) The Doppler ultrasound system of claim 90 wherein the ultrasound pulser circuit comprises an ultrasound pulser circuit configured to generate signals to drive groups of four adjacent quadrilateral shaped ultrasound transducer elements to radiate an ultrasound beam, and the ultrasound receiving circuit comprises an ultrasound receiving circuit configured to process signals detected from reflections of the ultrasound beam radiated by any of the groups of ultrasound transducer elements and generate the processed data therefrom.

92. (New) The Doppler ultrasound system of claim 87 wherein the computer comprises a computer configured to control the ultrasound pulser circuit to generate the signals driving the set of elements of the plurality of ultrasound transducers to radiate and steer the ultrasound beam by electronically controlling the elements of the set of ultrasound transducer elements, the computer further configured to control the ultrasound receiving circuit to process signals detected from reflections of the ultrasound beam radiated from the electronically controlled elements.

93. (New) The Doppler ultrasound system of claim 92 wherein the computer is configured to control the ultrasound pulser circuit to generate the signals driving the set of elements of the plurality of ultrasound transducers to radiate and steer the ultrasound beam by electronically phasing the elements and is further configured to control the ultrasound receiving circuit to process signals detected from reflections of the ultrasound beam radiated from the electronically phased elements.

94. (New) The Doppler ultrasound system of claim 87 wherein the computer comprises a computer configured to execute a pattern recognition algorithm that determines from the processed data the window through which blood flow is detected.

95. (New) A Doppler ultrasound system for monitoring blood flow, comprising:

an ultrasound transducer having a plurality of ultrasound transducer elements;

an ultrasound pulser circuit operatively coupled to the ultrasound transducer and configured to generate signals to drive a set of elements of the plurality of ultrasound transducer elements to radiate an ultrasound beam;

an ultrasound receiving circuit operatively coupled to the ultrasound transducer and configured to process signals detected from reflections of the ultrasound beam by at least a portion of the plurality of ultrasound transducer elements and generate processed data therefrom

representative of detected blood flow including reflected signal power of the detected blood flow; and

a computer operatively coupled to the ultrasound pulser circuit and the ultrasound receiving circuit, the computer configured to control the ultrasound pulser circuit to drive different sets of elements of the ultrasound transducer, control the ultrasound receiving circuit to generate processed data for the different sets of elements, and further configured to analyze the processed data for the different sets of elements to select one set of elements from which the ultrasound beam is radiated and blood flow is detected.

96. (New) The Doppler ultrasound system of claim 95 wherein the ultrasound transducer comprises an ultrasound transducer having an array of triangular shaped ultrasound transducer elements.

97. (New) The Doppler ultrasound system of claim 96 wherein the ultrasound pulser circuit comprises an ultrasound pulser circuit configured to generate signals to drive groups of six triangular shaped ultrasound transducer elements arranged in a hexagonal shape to radiate an ultrasound beam, and the ultrasound receiving circuit comprises an ultrasound receiving circuit configured to process signals detected from reflections of the ultrasound beam radiated by any of the groups of ultrasound transducer elements and generate the processed data therefrom.

98. (New) The Doppler ultrasound system of claim 95 wherein the ultrasound transducer comprises an ultrasound transducer having an array of quadrilateral shaped ultrasound transducer elements.

99. (New) The Doppler ultrasound system of claim 98 wherein the ultrasound pulser circuit comprises an ultrasound pulser circuit configured to generate signals to drive groups of four adjacent quadrilateral shaped ultrasound transducer elements to radiate an ultrasound beam, and the ultrasound receiving circuit comprises an ultrasound receiving circuit

configured to process signals detected from reflections of the ultrasound beam radiated by any of the groups of ultrasound transducer elements and generate the processed data therefrom.

100. (New) The Doppler ultrasound system of claim 95 wherein the computer comprises a computer configured to control the ultrasound pulser circuit to generate the signals driving the set of elements of the plurality of ultrasound transducers to radiate and steer the ultrasound beam by electronically controlling the elements of the set of ultrasound transducer elements, the computer further configured to control the ultrasound receiving circuit to process signals detected from reflections of the ultrasound beam radiated from the electronically controlled elements.

101. (New) The Doppler ultrasound system of claim 100 wherein the computer is configured to control the ultrasound pulser circuit to generate the signals driving the set of elements of the plurality of ultrasound transducers to radiate and steer the ultrasound beam by electronically phasing the signals driving the elements and is further configured to control the ultrasound receiving circuit to process signals detected from reflections of the ultrasound beam radiated from the electronically phased elements by phasing the detected signals.

102. (New) The Doppler ultrasound system of claim 95 wherein the computer comprises a computer configured to execute a pattern recognition algorithm that determines from the processed data which set of elements from which the ultrasound beam is radiated and blood flow is detected.

103. (New) A Doppler ultrasound system, comprising:

an ultrasound transducer having an array of ultrasound transducer elements;

an ultrasound pulser circuit coupled to the ultrasound transducer to drive a selected plurality of the ultrasound transducer elements to deliver an ultrasound beam;

a processing circuit coupled to the ultrasound transducer to process signals detected from reflections of the ultrasound beam by the selected plurality of ultrasound

transducer elements and generate Doppler shift data in response thereto representative of blood flow information; and

a computer coupled to the processing circuit to execute a software algorithm that analyzes the Doppler shift data and determines which of the selected plurality of ultrasound transducer elements of the array provide an optimum location from which to deliver ultrasound and detect the signals from reflections of the ultrasound beam to acquire blood flow information.

104. (New) The Doppler ultrasound system of claim 103 wherein the ultrasound transducer comprises an ultrasound transducer having an array of triangular shaped ultrasound transducer elements.

105. (New) The Doppler ultrasound system of claim 104 wherein the ultrasound pulser circuit comprises an ultrasound pulser circuit configured to generate signals to drive groups of six triangular shaped ultrasound transducer elements arranged in a hexagonal shape to deliver the ultrasound beam, and the processing circuit comprises a processing circuit configured to process signals detected from reflections of the ultrasound beam delivered by any of the groups of ultrasound transducer elements and generate the Doppler shift data representative of the blood flow information in response thereto.

106. (New) The Doppler ultrasound system of claim 103 wherein the ultrasound transducer comprises an ultrasound transducer having an array of quadrilateral shaped ultrasound transducer elements.

107. (New) The Doppler ultrasound system of claim 106 wherein the ultrasound pulser circuit comprises an ultrasound pulser circuit configured to generate signals to drive groups of four adjacent quadrilateral shaped ultrasound transducer elements to deliver the ultrasound beam, and the processing circuit comprises a processing circuit configured to process signals detected from reflections of the ultrasound beam delivered by any of the groups of

ultrasound transducer elements and generate the Doppler shift data representative of the blood flow information in response thereto.

108. (New) The Doppler ultrasound system of claim 103 wherein the computer comprises a computer further configured to control the ultrasound pulser circuit to generate the signals driving the set of elements of the plurality of ultrasound transducers to radiate and steer the ultrasound beam by electronically controlling the elements of the set of ultrasound transducer elements, the computer further configured to control the processing circuit to process signals detected from the reflections of the ultrasound beam radiated from the electronically controlled elements.

109. (New) The Doppler ultrasound system of claim 108 wherein the computer is configured to control the ultrasound pulser circuit to generate the signals driving the set of elements of the plurality of ultrasound transducers to radiate and steer the ultrasound beam by electronically phasing the signals driving the elements and is further configured to control the ultrasound receiving circuit to process signals detected from reflections of the ultrasound beam radiated from the electronically phased elements by phasing the detected signals.

110. (New) The Doppler ultrasound system of claim 108 wherein the processing circuit is further configured to process the signals detected from the reflections of the ultrasound beam radiated from the electronically controlled elements and generate Doppler shift data for a plurality of control conditions representative of blood flow information, and the computer is further configured to analyze the Doppler shift data for the plurality of control conditions to determine an optimum control condition to acquire blood flow information.

111. (New) The Doppler ultrasound system of claim 103 wherein the computer comprises a computer configured to execute a pattern recognition algorithm that determines from the Doppler shift data which selected plurality of ultrasound transducer elements provide an optimum condition.

112. (New) In a Doppler ultrasound system, a method of detecting blood flow, comprising:

providing an ultrasound transducer having a plurality of ultrasound transducer elements;

delivering ultrasound from groups of ultrasound transducer elements, each group defining a transmitting group;

analyzing signals detected from reflections of the ultrasound beam at groups of ultrasound transducer elements to determine blood flow information for each of the groups, each group defining a receiving group; and

determining from the blood flow information for each of the transmitting and receiving groups a selected transmitting group and a selected receiving group of ultrasound transducer elements representing an optimum set of ultrasound transducer elements for monitoring blood flow.

113. The method of claim 112 wherein a receiving group of ultrasound transducer elements at which reflected ultrasound signals are detected is the same as the transmitting group of ultrasound transducer elements from which the ultrasound is delivered.

114. (New) The method of claim 112 wherein providing the ultrasound transducer comprises providing an ultrasound transducer having an array of triangular shaped ultrasound transducer elements.

115. (New) The method of claim 114 wherein delivering ultrasound from transmitting groups of ultrasound transducers comprises delivering ultrasound from groups of six triangular shaped ultrasound transducer elements arranged in a hexagonal shape.

116. (New) The method of claim 112 wherein providing the ultrasound transducer comprises providing an ultrasound transducer having an array of quadrilateral shaped ultrasound transducer elements.

117. (New) The method of claim 116 wherein delivering ultrasound from transmitting groups of ultrasound transducers comprises delivering ultrasound from groups of four adjacent quadrilateral shaped ultrasound transducer elements.

118. (New) The method of claim 112, further comprising

electronically controlling the ultrasound transducer elements of a transmitting group to steer the ultrasound beam delivered by the transmitting group of ultrasound transducer elements;

processing signals detected from the reflections of the ultrasound beam radiated from the electronically controlled elements detected by a receiving group to generate processed data representative of detected blood flow and reflected signal power of the detected blood flow for a plurality of control conditions; and

analyzing the processed data for the plurality of control conditions to determine an optimum control condition for detecting blood flow.

119. (New) The method of claim 118 wherein electronically controlling the ultrasound transducer of a transmitting group to steer the ultrasound beam comprises electronically phasing the signals driving the transducer elements of a transmitting group and wherein processing signals detected from the reflections of the ultrasound beam radiated from the electronically controlled elements comprises processing signals detected from reflections of the ultrasound beam radiated from the electronically phased elements by phasing the detected signals.

120. (New) The method of claim 112, further comprising executing a pattern recognition algorithm to determine from the blood flow information the optimum location for detecting blood flow.

121. (New) In a Doppler ultrasound system, a method of determining an optimum window through which blood flow is detected, the method comprising:

selecting a region on a body surface of the patient;

placing on the body surface a single ultrasound probe having a plurality of transducer elements arranged in an array, the array defining a plurality of areas within the region;

administering ultrasound from the ultrasound probe to a first one of the areas;

evaluating a window through the first area;

if the window through the first area is not an optimum window, administering the ultrasound to a second one of the areas, at least a portion of the second area including at least a portion of the first area;

evaluating a window through the second area; and

repeating the administration of the ultrasound to another area if prior areas administered with ultrasound do not substantially include the optimum window, until an area having substantially the optimum window is located.

122. (New) The method of claim 121, further comprising

electronically controlling the ultrasound transducer elements of a transmitting group to steer the ultrasound beam delivered by the transmitting group of ultrasound transducer elements;

processing signals detected from reflections of the ultrasound beam radiated from the electronically controlled elements detected by a receiving group to generate processed data representative of detected blood flow and reflected signal power of the detected blood flow for a plurality of control conditions; and

analyzing the processed data for the plurality of control conditions to determine an optimum control condition for detecting blood flow.

123. (New) The method of claim 121 wherein electronically controlling the ultrasound transducer of a transmitting group to steer the ultrasound beam comprises electronically phasing the signals driving the transducer elements of the transmitting group and

wherein processing signals detected from the reflections of the ultrasound beam radiated from the electronically controlled elements comprises processing signals detected from reflections of the ultrasound beam radiated from the electronically phased elements by phasing the detected signals.

124. (New) The method of claim 121, further comprising executing a pattern recognition algorithm to determine from the blood flow information the optimum location for detecting blood flow.

REMARKS

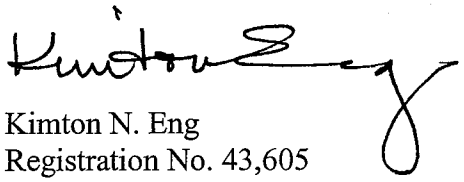
Claims 33, 40-44, 47-53, 63, 68-71, and 87-124 are currently pending in the present application. Claims 33, 40-44, 47-53, 63, and 68-71 were previously pending, and claims 87-124 have been added by amendment.

Claims 87-124 have been added to claim alternative embodiments of the invention described in the specification. Support for the subject matter of claims 87-124 can be found in the specification, including the figures and originally filed claims. No new matter has been added by claims 87-124.

All of the claims pending in the present application are in condition for allowance. Favorable consideration and a timely Notice of Allowance is earnestly solicited.

Respectfully submitted,

DORSEY & WHITNEY LLP



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